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Second Report on the Experiments carried out at Pusa to improve the Mulberry Silk Industry, compiled under the direction of the Imperial Entomologist

BY

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PREFACE.

THIS Report contains results of experiments in continuation of some of those inserted in the First Report (*Pusa Bulletin* No. 48) as well as some new experiments which will throw some further light on the behaviour of the various races of silkworms under Indian climatic conditions. It is hoped that the results obtained may perhaps be useful to those who are practically engaged in silkworm rearing on a large scale. We have succeeded in establishing multivoltine hybrid races whose yield of silk is better than that of pure multivoltine races generally reared in Bengal; we are not yet quite sure whether these races will not degenerate later on but up till now they are giving satisfactory results. It must however be noted that the yield of silk is inferior to that of univoltine races reared in some foreign countries like Japan, China, Italy, France, etc.

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Second Report on the Experiments carried out at Pusa to improve the Mulberry Silk Industry, compiled under the direction of the Imperial Entomologist.

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For the previous records of experiments with the hybrid races of the following Table, Table I, Bulletin No. 48, should be consulted.

In this Table multivoltine races have been crossed with univoltine races to see whether a multivoltine hybrid race which will yield better cocoons than pure multivoltine races, can be established.

TABLE I.

Race and generation		Date of oviposition	Number of univoltine layings	Number of multivoltine layings	Date of hatching	Date of mounting	Number of empty cocoons without pupal skin per 10 grammes	REMARKS
Nistari ♀ × French ♂ } ♂ F_{10} × Mysore ♀ . . }	F_2	16th August 1914	105	nil	26th August 1914	14th September 1914	68	For previous generations of this race, *vide* Table I, Bulletin No. 48. About 4 per cent. of the eggs hatched on 26th August 1914 and the rest on 14th April 1915.
Do.	F_3	25th September 1914	16	5	4th October 1914	5th November 1914	85	All the 15 mother moths were healthy.
Do.	F_4	21st November 1914	15	nil	15th December 1914	12th February 1915	140	About 60 eggs from some layings hatched naturally and the rest were sent to cold storage which hatched on 17th February 1915. All the three mother moths were healthy.
Do.	F_5	28th February 1915	nil	3	15th March 1915	10th April 1915	72	One mother moth was attacked with flacherie and the rest were healthy.
Do.	F_6	20th April 1915	3	15	29th April 1915	20th May 1915	70	One female moth was pebrinized and 22 were healthy.
Do.	F_7	29th May 1915	5	18	6th June 1915	27th June 1915	90	All the 24 female moths were healthy.
Do.	F_8	6th July 1915	5	19	14th July 1915	2nd August 1915	90	Four female moths were attacked with flacherie and 9 were healthy.
Do.	F_9	11th August 1916	1	12	19th August 1915	8th September 1915	95	Twelve female moths were attacked with flacherie and 29 were healthy.
Do.	F_{10}	17th September 1915	9	32	25th September 1915	14th October 1915	90	All the 41 female moths were healthy.
Do.	F_{11}	24th October 1915	5	36	2nd November 1915	1st December 1915	95	All the 42 female moths were healthy.
Do.	F_{12}	28th December 1915	36	11	3rd February 1916	16th March 1916	125	All the 11 female moths were healthy

Do.	F_{13}	28th March 1916	nil	11	6th April 1916	29th April 1916	..	Eight female moths were pebrinized and 109 were healthy.
Do.	F_{14}	9th May 1916	3	116	17th May 1916	..	..	....
Nistari ♀ × French ♂ × Mysore ♀ ♂ × Mysore ♀ ♂	F_1	21st August 1914	nil	all	29th August 1914	19th September 1914	72	Only multivoltine layings were reared in this as well as in succeeding generations.
Do.	F_2	30th September 1914	10	11	8th October 1914	3rd November 1914	72	1·5 per cent. of the female moths were pebrinized.
Do.	F_3	20th November 1914	6½	6½	8th December 1914	7th February 1915	160	All the 13 female moths examined, were healthy.
Do.	F_4	28th February 1915	nil	15	15th March 1915	10th April 1915	72	6 per cent. of the female moths were attacked with flacherie and the rest were healthy.
Do.	F_5	24th April 1915	nil	20	3rd May 1915	25th May 1915	90	In all two mother moths were examined which were healthy.
Do.	F_6	8rd June 1915	1	1	12th June 1915	2nd July 1915	75	The number of diseased moths was not recorded.
Do.	F_7	12th July 1915	8	12	20th July 1915	8th August 1915	70	80 per cent. of the female moths were attacked with flacherie and the rest were healthy.
Do.	F_8	19th August 1915	1½	28½	27th August 1915	14th September 1915	70	35·5 per cent. of the female moths were attacked with flacherie and the rest were healthy.
Do.	F_9	24th September 1915	22	49	2nd October 1915	20th October 1915	80	All the 16 female moths which were examined were healthy.
Do.	F_{10}	31st October 1915	9	7	11th November 1915	21st December 1915	120	All the 18 female moths that were examined were healthy.
Do.	F_{11}	17th January 1916	10½	7½	13th February 1916	22nd March 1916	120	All the 15 female moths that were examined were healthy.
Do.	F_{12}	2nd April 1916	nil	15	11th April 1916	4th May 1916	100	2 per cent. female moths were pebrinized and 1·5 per cent. were attacked with flacherie and the rest were healthy.
Do.	F_{13}	14th May 1916	11	238	22nd May 1916	17th June 1916	..	....

TABLE I—*concld.*

Race and generation		Date of oviposition	Number of univoltine layings	Number of multivoltine layings	Date of hatching	Date of mounting	Number of empty cocoons without pupal skin per 10 grammes	Remarks
French ♂ × Nistari ♀ } ♂ × Mysore ♀ } ♀ × Nistari ♀ } ♂ × Italian-Japanese ♂ } ♂	F_1	25th May 1915	3	2	1st June 1916	22nd June 1916	85	The results of rearing of the multivoltine races are recorded in this as well as in succeeding generations. All the 6 female moths were healthy.
Do.	F_2	2nd July 1915	4	2	16th July 1915	30th July 1915	65	Of the 7 moths examined, 2 were attacked with flacherie and the rest were healthy.
Do.	F_3	8th August 1915	1	6	17th August 1915	4th September 1915	75	All the 6 female moths were healthy.
Do.	F_4	13th September 1915	nil	6	22nd September 1915	11th October 1915	85	Of the 29 female moths examined, one was attacked with flacherie and the rest were healthy.
Do.	F_5	20th October 1915	10	19	5th March 1916	6th April 1916	..	The univoltine eggs were reared in this generation and the eggs were sent to cold storage for hibernation. Of the 6 female moths examined 2 were attacked with pebrine and the rest were healthy.
Do.	F_6	16th April 1916	1	5	25th April 1916	21st May 1916	..	The heat was abnormal this year and many died in the caterpillar stage and spun very poor cocoons. Of the 8 female moths examined, 1 was pebrinized and the rest were healthy.
Do.	F_7	30th May 1916	5	3	8th June 1916			

TABLE II.

Race	Number of multivoltine layings	Number of univoltine layings	Weight of eggs reared	Weight of leaves fed to the worms	Weight of green cocoons	Weight of raw silk	Price of raw silk and waste	Remarks
Nistari ♀ × French ♂ } ♂ } ♂ × Mysore ♀ × Mysore ♀ The results of this brood were not satisfactory as the temperature was very high this year when the worms were reared.	135 All the eggs were not reared.	47	1 oz.	35 maunds of bush leaves. Local men have been turned into rearers and therefore there is considerable waste of leaves.	40 seers (1 seer = 2 lb.)	2 seers 9 chattacks. Average denier of 450 metres = 13-15. Average tenacity for the same 36.80 grammes. Average elasticity for the same 17.08 per cent. The silk was reeled uniformly in a filature. The yield would have been more if *Khamroo* (coarse) raw silk was obtained from the cocoons.	The price of raw silk = Rs. 23-0-0. The price of waste = R1-8.	Eggs of another race were supplied to Umar Ali Biswas who obtained 21 seers of Khamroo raw silk from one maund of cocoons whereas from one maund of Nistari cocoons of the same Pund he obtained 3 seers of raw silk.
Madagascar ♀ × French ♂ } F_1	4	nil	..	..	1 lb. = 300 raw cocoons	..	..	Few eggs from some of these layings were univoltine.
Do. F_1	160	nil	..	..	1 lb. = 400 raw cocoons	..	..	
Do. F_1	128	nil	..	..	1 lb. = 450 raw cocoons	..	..	
Do. F_1	305	nil	..	..	1 lb. = 350 raw cocoons	..	..	

From the above table it will be seen that about 2 seers 9 chattacks of fine raw silk or 3 seers 12 chattacks of *khumroo* (coarse) raw silk were obtained from 40 seers of raw cocoons. The yield of cocoons from 1 oz. of eggs was 40 seers.

Better cocoons have been obtained from the three hybrid races than from the pure multivoltine races generally reared in Bengal, Assam and Burma. But they have not yet turned purely multivoltine. It appears that it will not be possible to get all the layings multivoltine from a hybrid race; a few layings at least will be univoltine in almost all the generations but, taking the yield of silk into consideration, the few univoltine layings can be discarded and multivoltine layings can be reared profitably. It is hoped that these hybrid races will yield more silk than pure multivoltine ones and perhaps the proper time has now come to introduce them in the rearing districts of Bengal.

It will be seen from the following table that if two pure multivoltine races are crossed, a few layings may become univoltine in some later generations. The hybrid univoltine eggs exhibit the characteristics of pure univoltine races but they hatch uniformly and regularly after a few months even if they are not sent to cold storage for hibernation; the natural local temperature is quite sufficient to make them hatch uniformly.

It has been seen that, by eliminating all the yellow cocoons from each generation and keeping only the white ones for reproduction, it is easy to get all white cocoons from a mongrel race; but it is difficult to get all yellow cocoons after many generations if white ones are eliminated in each generation and yellow ones are kept for reproduction. The number of white and yellow cocoons in each generation of the mongrel races are recorded in the remarks column. It will be seen that mongrel races yield better silk than pure multivoltine races up to some generations; but that ultimately degeneration sets in and then there is practically no difference between the mongrel races and the pure races.

We have seen that multivoltine Madagascar race and its crosses with the indigenous multivoltine races yield cocoons superior to those of the best indigenous multivoltine races and their crosses.

When the Assam race (multivoltine) was crossed with the Chotopolu race all the layings were multivoltine even up to the 8th generation.* It should be noted that, if the moths of the same multivoltine races, obtained from one place or from different localities, are crossed, the eggs remain multivoltine in all the generations. Hence it appears that the Assam and the Chotopolu races are one and the same.

* The "mongrel" race could not be continued after 8th generation on account of scarcity of leaves.

TABLE III.

Race	Number of univoltine layings	Number of multivoltine layings	Date of oviposition	Date of hatching	Date of mounting	Number of empty cocoons without pupal skin per 10 grammes	Remarks
Mysore ♀ × Nistari ♂ F_{18}	nil	50	14th October 1914	25th October 1914	21st November 1914	108	For previous generations, *vide* Bulletin No. 48, page 17. 3·5 per cent. of the mother moths were pebrinized and the rest were healthy. The worms spun 3,555 yellow cocoons and 104 white ones. Yellow ones were kept for reproduction in all the generations.
Do. F_{19}	12½	15½	11th December 1914	9th January 1915	21st February 1915	140	All the mother moths were healthy. The worms spun 272 yellow cocoons and 3 white ones.
Do. F_{20}	nil	16	10th March 1915	24th March 1915	17th April 1915	136	Number of diseased moths not recorded. All the cocoons were yellow.
Do. F_{21}	nil	18	26th April 1915	4th May 1915	25th May 1915	100	All the mother moths were healthy.
Do. F_{22}	nil	10	31st May 1915	8th June 1915	28th June 1915	90	About 6·5 per cent. of the female moths were affected with flacherie and the rest were healthy. The worms spun 1,922 yellow cocoons and 10 white ones.
Do F_{23}	nil	16	8th July 1915	16th July 1915	4th August 1915	100	About 9 per cent. of the mother moths were affected with pebrine and the rest were healthy.
Do. F_{24}	4	252	13th August 1915	21st August 1915	9th September 1915	70	20 per cent. of the mother moths were affected with pebrine and the rest were healthy. All the cocoons were yellow.
Do. F_{25}	12	10	18th September 1915	26th September 1915	15th October 1915	90	All the mother moths were healthy. All the cocoons were yellow.
Do. F_{26}	1	9	25th October 1915	3rd November 1915	30th November 1915	110	4·5 per cent. of the mother moths were attacked with flacherie and the rest were healthy. The worms spun 801 yellow cocoons and 7 white ones.
Do. F_{27}	14	32	26th December 1915	28th January 1916	13th March 1916	165	All the 105 mother moths were healthy. All the 212 cocoons were yellow.

TABLE III—*contd.*

Race	Number of univoltine layings	Number of multivoltine layings	Date of oviposition	Date of hatching	Date of mounting	Number of empty cocoons without pupal skin per 10 grammes	REMARKS
Mysore ♀ × Nistari ♂ } F_{33}	nil	14	23rd March 1916	2nd April 1916	24th April 1916	..	1·5 per cent. of the mother moths were pebrinized and the rest were healthy. All the 305 cocoons were yellow.
Do. F_{34}	nil	140	5th May 1916	14th May 1916	7th June 1916	..	....
Assam ♀ × Nistari ♂ } F_1	nil	all	2nd December 1914	8th February 1915	28th February 1915	120	All the 15 mother moths were healthy. The worms spun 40 yellow cocoons in all. Yellow cocoons were kept for reproduction in all the generations and white ones were destroyed.
Do. F_2	nil	15	28th February 1915	15th March 1915	9th April 1915	90	Two female moths were attacked with flacherie and 10 were healthy. The worms spun 1,070 yellow cocoons which were kept for reproductive purposes in this as well as in succeeding generations and 362 white cocoons.
Do. F_3	nil	21	19th April 1915	28th April 1915	18th May 1915	80	All the 13 mother moths were healthy. The worms spun 144 white cocoons and 972 yellow cocoons.
Do. F_4	nil	13	28th May 1915	6th June 1915	25th June 1915	95	All the 24 female moths were healthy. The worms spun 585 yellow cocoons and 86 white cocoons.
Do. F_5	nil	24	4th July 1915	12th July 1915	9th August 1915	90	One female moth was attacked with flacherie and 8 were healthy. The worms spun 256 yellow cocoons and 7 white ones.
Do. F_6	nil	9	9th August 1915	18th August 1915	6th September 1915	80	All the 12 mother moths were healthy. All the cocoons were yellow.
Do. F_7	1	11	14th September 1915	22nd September 1915	11th October 1915	70	All the 44 female moths were healthy. All the 185 cocoons were yellow.
Do. F_8	22	22	20th October 1915	29th October 1915	24th November 1915	95	One mother moth was pebrinized and 10 were healthy.

Assam ♀ × Chotopolu ♂	F_1	nil	all	30th November 1914	24th December 1914	3rd March 1915	144	All the 15 mother moths were healthy. All the cocoons were yellow. Pure Chotopolu race spun yellow cocoons and Assam race greenish white cocoons.
Do.	F_1	nil	15	3rd March 1915	18th March 1915	24th April 1915	135	All the 23 mother moths were healthy. The worms spun 55 white cocoons and 205 yellow ones. White cocoons in this as well as in succeeding generations were destroyed and yellow cocoons were kept for reproductive purposes.
Do.	F_2	nil	23	24th April 1915	3rd May 1915	27th May 1915	135	One female moth was pebrinized and 17 were healthy. The worms spun 42 white cocoons and 380 yellow ones.
Do.	F_4	nil	8	5th June 1915	18th June 1915	3rd July 1915	104	The number of diseased moths was not recorded. The worms spun 21 white and 137 yellow cocoons.
Do.	F_5	nil	19	12th July 1915	20th July 1915	9th August 1915	100	One female moth was attacked with flacherie and 16 were healthy. The worms spun 646 yellow cocoons and 56 white ones.
Do.	F_6	nil	17	19th August 1915	29th August 1915	16th September 1915	105	Seven female moths were attacked with flacherie, one was pebrinized and 25 were healthy. The worms spun 287 yellow and 9 white cocoons.
Do.	F_7	nil	33	26th September 1915	4th October 1915	24th October 1915	98	One female moth was attacked with pebrine and 4 were healthy. The worms spun 287 yellow and 13 white cocoons.
Do.	F_8	nil	5	6th November 1915	19th November 1915	8th January 1916	..	The race was discontinued as sufficient leaves were not available in winter.
Nistari ♂ × Chotopolu ♀	F_1	nil	3	28th February 1915	17th March 1915	14th April 1915	140	For previous generations of this race, *vide* First Report, Table XI, page 26. In all two mother moths were examined which were healthy. The worms spun 9 yellow and one white cocoons. Yellow cocoons only were kept for reproduction and white ones were destroyed in all the generations.
Do.	F_2	nil	2	23rd April 1915	2nd May 1915	22nd May 1915	98	One mother moth was pebrinized and 9 were healthy. The worms spun yellow cocoons only.
Do.	F_3	nil	10	31st May 1915	8th June 1915	28th June 1915	105	All the 10 female moths were healthy. The worms spun 670 yellow cocoons and 8 white ones.
Do.	F_{10}	nil	10	6th July 1915	14th July 1915	2nd August 1915	85	Five female moths were attacked with flacherie and 14 were healthy. The worms spun 145 yellow cocoons in all.

TABLE III—*concld.*

Race	Number of univoltine layings	Number of multivoltine layings	Date of oviposition	Date of hatching	Date of mounting	Number of empty cocoons without pupal skin per 10 grammes	REMARKS
Nistari ♀ × Chotopolu ♂ F_{12}	1	18	10th August 1915	20th August 1915	8th September 1915	90	Six mother moths were attacked with flacherie and 24 were healthy. The worms spun 692 yellow cocoons and 38 white ones.
Do. F_{11}	nil	30	17th September 1915	25th September 1915	13th October 1915	95	One female moth was attacked with flacherie and 89 were healthy. The worms spun 610 yellow cocoons and 50 white ones.
Do. F_{13}	nil	40	22nd October 1915	3rd November 1915	1st December 1915	110	The worms spun 561 yellow cocoons and 63 white ones.
Do. F_{14}	29	26	27th December 1915	29th January 1916	10th March 1916	160	All the 18 female moths were healthy. The worms spun 467 yellow cocoons and 27 white ones.
Do. F_{15}	nil	18	22nd March 1916	2nd April 1916	25th April 1916	..	One female moth was pebrinized and 12 were healthy.
Do. F_{16}	nil	100	..	..	..	..	The race was discontinued.

Mr. Kawahito, the Director of Aichiken Sericulture Experimental Station, Japan, has been reported to get an improvement in the cocoons of univoltine races by immersing the eggs in dilute hydrochloric acid. The following experiment was carried out here on a similar line with a multivoltine race and the result is shown below.

TABLE IV.

Race	Treatment of eggs	Date of oviposition	Date of hatching	Number of cocoons per 10 grammes
Asaam ♀ × Chotopoli ♂ F,	Normal eggs . .	26th September 1915	4th October 1915	13 raw, 80 pierced, 90 empty.
Do.	Eggs dipped in dilute hydrochloric acid from 8-30 P.M. of 3rd October 1915 to 8 A.M. of 4th October 1915	Do.	Majority hatched on 4th October 1915 but a few on 5th October 1915	15 raw, 85 pierced, 105 empty.
Do.	Eggs dipped in dilute hydrochloric acid from 8-30 P.M. of 3rd October 1915 to 8 A.M. of 4th October 1915	Do.	Few eggs hatched on 4th October 1915 but the majority hatched on 5th October 1915	13 raw, 80 pierced, 90 empty.

Thus it is seen that better cocoons were not obtained by keeping eggs of multivoltine races in dilute hydrochloric acid.

The following experiment was undertaken to see whether better cocoons can be obtained by increasing the number of feedings, the conditions of rearing remaining the same.

TABLE V.

Race	Date of hatching	Date of mounting	Number of feedings per day	Number of cocoons per 10 grammes
Multivoltine hybrid race	10th July 1915	30th July 1915	12	10 raw, 65 pierced, 70 empty.
Do.	10th July 1915	1st August 1915	9	9 raw, 60 pierced, 70 empty.
Do.	Do.	Do.	8	11 raw, 75 pierced, 80 empty.
Do.	Do.	Do.	6	12 raw, 70 pierced, 80 empty.
Do.	9th July 1915	28th July 1915	6	10 raw, 65 pierced, 75 empty.

It is seen that the yield of silk can be increased by increasing the number of feedings but the advantage obtained is not proportionate to the extra trouble and cost required for the purpose.

The following experiment was undertaken to find out which variety of mulberry gives the most satisfactory results in the yield and other qualities of silk and the percentage of diseases in the mother moths.

The following varieties of mulberry were used in this experiment :—

1. *Morus indica*, male.
2. *Morus indica*, female.
3. Bengal bush.
4. Philippine variety.
5. Japanese variety.
6. Italian variety.

TABLE VI.

Race	Variety of mulberry leaves served to the worms	Date of hatching	Date of maturity	Number of cocoons per 10 grammes	Percentage of pebrinized moths	Percentage of healthy moths	Average length of thread in one cocoon in metres	Average denier of one filament for the length of 450 metres	Average denier of five filaments for the length of 450 metres	Average tenacity for the length of 450 metres	Percentage of elasticity for the same
Boropolu ♀ × Japanese ♂ F_1	*Morus indica*, male medium tree	3rd March 1916	1st April 1916	13 raw, 75 pierced, 105 empty	29	71	371·43	1·75	9·50	39·3	8·88
Do.	*Morus indica*, female medium tree	4th March 1916	Do.	12 raw, 75 pierced, 100 empty	30	70	364·64	1·87	9·75	33·0	14·66
Do.	*Morus alba* var. *indica*, Bengal bush	5th March 1916	4th April 1916	15 raw, 75 pierced, 105 empty	35	65	349·60	1·87	9·00	32·4	13·40
Do.	*Morus alba* var. *philippinensis*, tree	Do.	3rd April 1916	11 raw, 80 pierced, 100 empty	43	57	413·51	1·64	9·00	35·4	15·20
Do.	*Morus alba* var. *japanica*, tree	Do.	Do.	10 raw, 70 pierced, 85 empty	30	70	467·60	1·78	9·00	33·7	12·74
Do.	*Morus alba* of Italy, tree	Do.	Do.	14 raw, 100 pierced, 135 empty	41	59	330·60	1·58	7·50	29·6	12·10

Taking the yield of silk and other things into consideration Japanese mulberry stands first, Philippine variety and *Morus indica*, female, stand second ; Bengal bush and *Morus indica*, male, stand third and Italian variety stands last. It should be noted that a crop of leaf can be obtained from Japanese and Philippine varieties earlier in the spring, so that the spinning of cocoons may begin before the advent of the hot season. The Japanese variety yields many fruits but the Philippine variety yields very few, about 90 per cent. of the flowers being males. There is practically no difference between the leaves of male and female varieties of *Morus indica* though the latter gave a little better result than the former ; the female variety yields many fruits but the male one does not bear a single fruit, all the flowers being males. The leaves of the Italian variety are very big and hard and not suitable for feeding the worms. The Bengal bush variety does not bear fruits as it is not allowed to grow more than 4 or 5 feet high. This variety would no doubt yield better results if it is allowed to grow into a big tree.

The leaves of the six varieties of mulberry were analysed in the Chemical Laboratory of Pusa with the following results :—

TABLE VII.

	Morus indica, male medium tree	*Morus indica*, female medium tree	*Morus alba* var. *indica*, Bengal bush	*Morus alba* var. *philippinensis*	*Morus alba* var. *japonica*	*Morus alba* of Italy
	Per cent.	Per cent.	Per cent.	Per cent	Per cent.	Per cent.
Moisture	68·82	69·30	65·69	66·63	64·46	69·02
Dry matter	31·18	30·70	34·31	33·37	35·54	30·98
	Per cent. on dry matter	Per cent. on dry matter	Per cent. on dry matter	Per cent. on dry matter	Per cent. on dry matter	Per cent. on dry matter
Organic matter . . .	80·89	85·93	84·19	86·57	86·66	90·50
Fat, resinous substances, etc. .	3·86	3·72	4·03	3·43	5·06	3·40
Pure protein	24·40	23·93	26·54	17·81	20·49	16·00
Crude protein . . .	27·05	25·65	28·82	19·68	21·88	16·50
Nitrogenous non-albuminous substance	2·65	1·93	2·28	1·87	1·39	0·81
Soluble carbohydrate . .	50·41	50·63	46·90	56·54	52·96	62·28
Woody fibre	7·72	7·64	7·32	8·79	8·15	8·73
Ash	13·61	14·07	15·21	13·43	13·34	9·50

One of the dangerous diseases of silkworms is pebrine which is hereditary and contagious. It is essential that the eggs, laid by a mother moth

which is attacked with pebrine, should be destroyed and only those laid by healthy moths should be used for reproductive purposes. The contagious and hereditary nature of the disease is apparent from the following experiments carried out at Pusa in August 1911. All the worms used in the experiment were kept in the same room and the conditions of rearing were the same as are generally followed by the cultivators. The average temperature and moisture-content of the room from the date of hatching to that of maturity were as under.

Date	Average dry temperature of the rearing room	Average humidity of the air of the rearing room
	° F.	Per cent.
15th August 1911	82·5	88·0
16th " "	82·5	91·5
17th " "	84·5	85·5
18th " "	82·5	89·5
19th " "	81·5	90·5
20th " "	80·8	93·5
21st " "	81·0	93·0
22nd " "	80·5	91·0
23rd " "	79·5	91·5
24th " "	81·5	91·5
25th " "	82·5	87·5
26th " "	83·5	88·0
27th " "	81·5	93·0
28th " "	82·5	88·5
29th " "	83·5	83·5
30th " "	82·5	86·5
31st " "	82·5	88·5
1st September 1911	84·5	85·0
2nd " "	84·5	83·5
3rd " "	83·0	85·5
4th " "	83·5	85·0
5th " "	83·5	85·5
6th " "	83·0	88·0
7th " "	81·5	91·5
8th " "	79·5	92·5
9th " "	82·5	86·5

In this experiment (1) 10 healthy and 2 pebrinized layings, (2) 10 healthy and 3 pebrinized layings, (3) 10 healthy and $7\frac{1}{2}$ pebrinized layings, (4) 10 healthy and 5 pebrinized layings, (5) 10 healthy and 10 pebrinized layings, (6) 10 healthy layings, (7) 10 healthy and $2\frac{1}{2}$ pebrinized layings, (8) 10 healthy and one pebrinized layings, (9) 10 healthy and $\frac{1}{2}$ pebrinized layings, (10) 4 pebrinized layings and 10 healthy ones and (11) 10 pebrinized layings were reared separately in the same room in 11 consignments and their results are recorded in Table VIII.

TABLE VIII.

	Race	Number of healthy layings	Number of pebrinized layings	Number of worms reared	Number of cocoons obtained	Weight of cocoons obtained	Percentage of pebrinized moths	Percentage of healthy moths	REMARKS
						Chattacks			
1	Nistarf ♀ × Mysore ♂ } F_1	10	2	3,740	504	6	67·5	32·5	Healthy and diseased worms were mixed and reared together.
2	Do.	10	3	4,015	740	7¼	96·0	4·0	Do.
3	Do.	10	7½	5,162	1,163	13½	100·0	nil	Do.
4	Do.	10	5	4,475	603	7	96·0	4·0	Do.
5	Do.	10	10	5,850	507	6½	86·0	14·0	Do.
6	Do.	10	nil	3,197	921	10	78·0	22·0	Healthy eggs only were reared in this consignment.
7	Do.	10	2½	3,787	1,683	18¼	88·0	12·0	Healthy and diseased worms were mixed and reared together.
8	Do.	10	1	3,373	1,145	11½	94·5	5·5	Do.
9	Do.	10	½	3,287	1,021	11	67·5	32·5	Do.
10	Do	10	4	4,200	1,038	12¾	30·0	70·0	Do.
11	Do.	nil	10	2,753	35	..	100·0	nil	Only diseased eggs were reared in this consignment.

It has been seen that the best results were obtained from 10 healthy layings and the worst from the 10 layings laid by diseased moths. From the 10 healthy layings 921 cocoons were obtained, whereas, from the 10 diseased layings only 35 cocoons were obtained and from the consignment in which 10 healthy and 10 diseased layings were reared only 507 cocoons were obtained. The greater the number of diseased layings reared with the 10 healthy layings, the less were the number of cocoons obtained and the percentage of diseased moths in each consignment was more or less in proportion to the number of diseased layings reared with the 10 healthy layings. It should be noted in this connection that all the eggs laid by a pebrinized moth do not contain pebrine germs. Pebrine spores can be seen in some of the eggs and these multiply with the growth of the embryos but the majority of the eggs are quite healthy. Pebrine spores cannot be seen in the eggs laid by a moth whose generative organ is not attacked with pebrine; if the moth is attacked with pebrine in other parts the germs of the disease may be visible on the egg-shells but these can be washed off with water. Good cocoons and disease-free moths can be obtained from a pebrinized laying if the worms are reared separately and if special care is taken. On the other hand, bad cocoons and diseased moths are obtained from a healthy laying if the worms are not properly attended to and if the temperature and moisture-content in the air are high.

A rearing of the above race was commenced at the same time with healthy layings in a separate room on a large scale. The crop was a successful one; about 94 per cent. of the hatched worms spun cocoons and only 4 per cent. of the female moths were pebrinized.

It has been shown in the First Report that univoltine races are more susceptible to the disease than multivoltine races in a climate like that of Pusa.

In Assam where mulberry silkworm is reared only on a small scale and in the households of cultivators, diseased eggs are not eliminated by the microscopical examination of the moths and the percentage of this disease in moths is about 3 to 4. The room in which the worms are reared is kept very neat and clean and a fire is moreover kept in the rearing room. On account of the cleanliness and the smoke of the fire the germs of the pebrine are kept in check. In Bengal about 50 per cent. pebrine is seen in moths of those localities where microscopical examination is not practised and the worms of many rearers perish on account of this disease. In Japan and Europe where microscopical examination of the moths is undertaken pebrine is present in about 4 to 5 per cent. of the moths.

It has been noticed that the disease is more prevalent during the months of May to October than from November to April. Moisture

and heat appear to help the rapid multiplication of pebrine. A high temperature and moisture-content in the air are not suitable for the healthy development of the worms especially when they are meant to be used for reproductive purposes though these conditions cause a rapid growth of the worms. Pebrine spores may enter into the system of the worms with the leaves eaten by them. Worms may also contract the disease through wounds on their bodies.

It is advisable to keep the mother moths in a box for about four hours only, isolated in paper bags on the second day after oviposition, the temperature of which should be about 180°F, and crush them well in separate pestles and mortars on the 6th or 7th day after oviposition for the Pasteur system of examination. The bags containing the moths can also be dried by exposing them in the sun. The number of the bag containing a moth should correspond with the number of the laying oviposited by it so that the eggs laid by each moth can be ascertained and those laid by diseased moths can be destroyed after examination.

There is another disease of silkworms called flacherie which, according to some, is hereditary but according to others not so. During the rains when the temperature is high and the air is wet many moths are attacked with flacherie though they oviposit the normal number of eggs. The following experiment was undertaken to find out whether good crops could be obtained from eggs laid by moths attacked with flacherie and the results are compared with the cocoons obtained from eggs laid by healthy moths of the same races. All the worms were reared in the same room and under similar conditions.

TABLE IX.

Race	Diseased or healthy eggs	Date of hatching	Date of maturity	Rearing whether successful	Number of cocoons in 10 grammes	Percentage of moths attacked with flacherie	Percentage of moths attacked with pebrine	Percentage of healthy moths	REMARKS
Mysore ♀ × Nistari ♂ F_{25}	Healthy	4th July 1914	23rd July 1914	Successful	13 raw and 95 empty	5	4	91	The eggs were disinfected with 2 per cent. $CUSO_4$ solution.*
Do.	Eggs laid by moths attacked with flacherie	Do.	Do.	Do.	10 raw and 86 empty	25	4	71	
Mysore ♀ × Nistari ♂ F_{26}	Healthy	9th August 1914	27th August 1914	Do.	12 raw and 96 empty	0·3	6·2	84·5	The eggs were disinfected with $CUSO_4$ solution.
Do.	Eggs laid by moths attacked with flacherie	10th August 1914	28th August 1914	Do.	12 raw and 98 empty	68	6	26	
Mysore ♀ × Nistari ♂ F_{34}	Do.	21st August 1915	9th September 1915	Do.	12 raw and 90 empty	8	nil	92	
Do.	Healthy	Do.	Do.	Do.	10 raw and 79 empty	20	nil	80	The eggs were disinfected with $CUSO_4$ solution.
Chotopo.u	Eggs laid by moths attacked with flacherie	21st September 1915	12th October 1915	Do.	12 raw and 95 empty	14	nil	85	
Do	Healthy	22nd September 1915	13th October 1915	Do.	13 raw and 105 empty	4	nil	96	The eggs were disinfected with $CUSO_4$ solution.
Nistari	Do.	28th September 1915	18th October 1915	Do.	12 raw and 90 empty	nil	nil	100	
Do.	Eggs laid by moths attacked with flacherie	30th September 1915	20th October 1915	Do.	13 raw and 100 empty	nil	nil	100	
Hybrid race, 8th generation	Do.	23rd September 1915	13th October 1915	Do.	9 raw and 70 empty	5	nil	95	The grandmothers of this consignment were also attacked with flacherie.
Do.	Healthy eggs	24th September 1915	12th October 1915	..	8 raw and 65 empty	6	nil	94	The grandmothers of this consignment were healthy.
Hybrid race, 9th generation	Eggs laid by moths attacked with flacherie	2nd November 1915	1st December 1915	Do.	11 raw and 80 empty	nil	nil	100	The grandmothers and great grandmothers of this lot were attacked with flacherie.
Do.	Healthy eggs	31st October 1915	28th November 1915	Do.	10 raw and 72 empty	nil	nil	100	The grandmothers and great grandmothers of this lot were healthy.

*For disinfecting rearing rooms and appliances formaline is the best though it is very expensive (*Vide* Bull. No. 39, page 5). SO_4 gas is not effective for the purpose. Pebrine spores cannot be killed with $CUSO_4$ solution. †The rearing appliances can be disinfected with steam.

Hence we can conclude that the eggs, laid by moths which were attacked with flacherie, can be safely kept for industrial purposes though in some cases the cocoons are a little inferior to those obtained from the eggs laid by healthy moths.

In the First Report it has been shown that the temperature suitable for the uniform hatching of univoltine eggs is about 30°-40°F. and that it is quite possible to preserve the eggs in Hill Stations such as Shillong, Simla, Naini Tal, Darjeeling, etc., where the natural temperature in winter (from October to February) varies from 60°-30° F. and that the duration of cold storage should be about four months (*vide* Bulletin No. 48, pages 1, 2 and 23).

The following experiment was undertaken to find out whether it is possible to shorten the duration of cold storage by increasing the intensity of cold and to study the effect of intense cold on the embryos. We are indebted to the Director of the King Institute of Preventive Medicine, Guindy, Madras, for keeping the eggs in his cool rooms.*

* For temperature of cool and cooler rooms, *see* Table XII.

TABLE X.

Race	Date of oviposition	Number of layings	Temperature of the cold storage and treatment there	Duration of hatching	Number of worms hatched	Hatching whether regular	Remarks
French ♀ × Boropolu ♂ } F_1	24th April 1915	37*	11°-30° F. from 18th June 1915 to 5th November 1915	26th February 1916 to 15th May 1916	5,113	Very irregular	Few hatched on 4th June 1915. The embryos of some were affected and some eggs seemed to be in good condition but they were injured in the cold storage and failed to hatch.
French acclimatized eggs	26th April 1915	20	Do.	18th February 1916 to 12th May 1916	53	Do.	The embryos of some were injured.
Chinese acclimatized eggs	28th April 1915	8	Do.	21st March 1916 to 27th April 1916	15	Do.	The embryos of many were injured.
Japanese ♀ × Boropolu ♂ } F_1	18th April 1915	20	Do.	2nd February 1916 to 29th May 1916	..	..	Few hatched on 4th June 1916. The embryos of many were injured.
Boropolu ♀ × Japanese ♂ } F_1	18th April 1915	21	Do.	28th January 1916 to 15th May 1916	1,423	Irregular	Few hatched on 4th June 1916. The embryos of some were injured.
Boropolu	15th April 1915	4	Do.	28th January 1916 to 30th March 1916	860	Do.	The embryos of few were injured.
Chotopolu ♀ × Boropolu ♂ } F_1	17th May 1915	8	Do.	6th February 1916 to 8th April 1916	719	Do.	The embryos of some were injured.
French ♀ × Chinese ♂ } F_1	28th April 1915	37	Do.	18th February 1916 to 22nd May 1916	271	Do.	The embryos of many were injured.
French ♀ × Nistari ♂ × Mysore ♀ } F_4	19th May 1916	3	Do.	2nd February 1916 to 27th April 1916	233	Do.	The embryos of some were injured.
French ♀ × Nistari ♂ × Mysore ♀ × Mysore ♀ } F_4	Do.	8	Do.	27th January 1916 to 23rd April 1916	651	Do.	Do.
Mysore ♀ × Nistari ♂ × French ♂ × Chotopolu ♀ } F_3	9th April 1915	11	Do.	29th January 1916 to 17th March 1916	1,822	Do.	The embryos of few were injured and some eggs dried up in the cold storage.
Imported French eggs	1 July 1915	1 oz. or 40,000	11°-30° F. from 1st November 1915 to 3rd March 1916	25th March 1916 to 25th April 1916	429	Do.	The embryos of many were injured. 3 oz. of eggs of the same lot were sent to Muktesar for cold storage and kept there at 60°-30° F. from 30th October 1915 to 3rd March 1916. All the eggs hatched regularly in five days.

* One laying contains about 250 eggs.

Some of the eggs of the above races were kept in a dark room of the Pusa Silk house from October to March 1915 and they began to hatch non-uniformly from 26th January 1916.

Univoltine eggs of 9 different varieties were divided in five parts and kept in five bags. Each of these bags was treated in cold storage in the following way :—

No. 1 bag kept in the cooler room for one month.

No. 2 bag kept in the cooler room for two months.

No. 3 bag kept in the cool room for 15 days, shifted to the cooler room and kept there for 15 days and shifted back to cool room and kept there for 15 days and then taken out for incubating.

No. 4 bag kept in the cool room for 15 days, shifted to the cooler room and kept there for 32 days and shifted back to cool room and kept there for 15 days and then taken out for incubating.

No. 5 bag kept in the cool room for 3 months.

The results are recorded in the following Table :—

TAB

Race	Date of oviposition	Bag No. 1 kept in cooler room on 20th December 1915 and taken out on 21st January 1916 for incubating				Bag No. 2 kept in cooler room on 20th December 1915 and taken out on 21st February 1916 for incubating			
		Number of layings	Duration of hatching	Number of hatched worms	Remarks	Number of layings	Duration of hatching	Number of hatched worms	Remarks
French	2nd April 1915	½	22nd February 1916 to 15th May 1916	16	The embryos of many eggs were injured	½	21st February 1916 to 24th February 1916	5	The embr were inju and there the wo could come out
Chinese	28th April 1915	3	21st February 1916 to 3rd April 1916	191	Do.	6	21st March 1916 to 24th April 1916	108	Many embr were inju and the failed hatch
Boropolu	31st March 1915	2	18th February 1916 to 12th March 1916	444	Few eggs did not hatch and seemed to have been injured	3	12th March 1916 to 30th March 1916	753	Some embry were injur and there the eggs re not hatch
Chinese ♀ × French ♂ } F_1	28th April 1915	1	12th March 1916 to 17th April 1916	31	Many eggs were injured	1	27th March 1916	2	The rest the embry dried up
Boropolu ♂ × French ♀ } F_1	23rd April 1915	1	18th February 1916 to 23rd March 1916	262	Few eggs were injured	1	21st March 1916 to 23rd April 1916	72	Do
Mysore ♀ × Nistari ♂ × Boropolu ♀ } F_3	3rd December 1915	4	18th February 1916 to 17th March 1916	500	Some eggs did not hatch and some embryos were injured	3	12th March 1916 to 27th March 1916	1178	Very few bryos we injured
Italian ♀ × Japanese ♂ × Nistari ♀ } ♂ × Mysore ♀ } F_2	16th December 1915	3	14th March 1916 to 16th April 1916	296	Many embryos were injured and failed to hatch	3	3rd April 1916 to 11th April 1916	10	Most of embryos w injured
Hybrid univoltine eggs	24th October 1915	2	18th February 1916 to 3rd April 1916	?	Few embryos were injured and failed to hatch	2	17th March 1916 to 18th April 1916	235	Some embr were injur
Eri eggs	10th December 1915	5	..	nil	All the embryos were injured and failed to hatch	5	..	nil	All the bryos w injured

BAG No. 3 KEPT IN COOL ROOM ON 20TH NOVEMBER 1915, SHIFTED TO COOLER ROOM ON 5TH JANUARY 1916 AND THEN SHIFTED BACK TO COOL ROOM ON 20TH JANUARY 1916 AND THEN KEPT FOR INCUBATING ON 5TH FEBRUARY 1916			BAG No. 4 KEPT IN COOL ROOM ON 20TH DECEMBER 1915, SHIFTED TO COOLER ROOM ON 5TH JANUARY 1916, SHIFTED BACK TO COOL ROOM ON 7TH FEBRUARY 1916 AND TAKEN OUT ON 21ST FEBRUARY 1916 FOR INCUBATING			BAG No. 5 KEPT IN COOL ROOM ON 20TH DECEMBER 1915 AND TAKEN OUT ON 21ST FEBRUARY 1916 AND THEN KEPT FOR INCUBATING			
Duration of hatching	Number of hatched worms	REMARKS	Number of layings	Duration of hatching	Number of hatched worms	REMARKS	Number of layings	Duration of hatching	Number of hatched worms	REMARKS
21st February 1916 to 5th March 1916	28	Many embryos were injured	4	12th March 1916 to 27th March 1916	2	Most of the embryos were injured in the cold storage	..	..	..	The eggs were missing
11th February 1916 to 24th March 1916	446	Some embryos were injured	1	5th March 1916 to 3rd April 1916	810	Some embryos were injured in the cold storage	1	7th March 1916 to 17th March 1916	182	Few embryos were injured in the cold storage
18th February 1916 to 5th March 1916	330	Do.	2	5th March 1916 to 12th March 1916	470	Few embryos were injured in the cold storage	4	3rd March 1916 to 9th March 1916	1135	The hatching was satisfactory
3rd March 1916 to 21st March 1916	185	Some embryos were injured in the cold storage	1	7th March 1916 to 21st March 1916	242	Very few embryos were injured	3	3rd March 1916 to 14th March 1916	233	Many embryos were injured
21st February 1916 to 7th March 1916	231	Few embryos were injured in the cold storage	1	5th March 1916 to 12th March 1916	260	Do.	1	28th February 1916 to 9th March 1916	288	Few embryos were injured
26th February 1916 to 7th March 1916	345	Do.	4	5th March 1916 to 9th March 1916	720	1 laying did not hatch at all. The embryos of the rest were in good condition	1	5th March 1916 to 9th March 1916	91	Many embryos were injured
18th February 1916 to 14th March 1916	420	Some eggs were injured in cold storage	3	12th March 1916 to 17th March 1916	442	Few embryos were injured in the cold storage	4	7th March 1916 to 13th March 1916	545	Some eggs did not hatch
9th February 1916 to 12th March 1916	445	Few eggs were injured in the cold storage	2	5th March 1916 to 12th March 1916	547	Do.	1	3rd March 1916 to 9th March 1916	322	All hatched
..	nil	All the embryos were injured in the cold storage	5	..	nil	All the embryos were injured	10	..	..	About half the eggs hatched in the cold storage. The rest dried up. Many broke the egg-shells but could not come out

Thus it has been seen that the period of cold storage can be shortened if the cold is more intense in the hibernating room but many of the embryos are injured and the hatching isnon-uniform and quite unsatisfactory. When the eggs were taken out from the intense cold they seemed to be in good condition but after two to three months slight depressions were visible on the eggs, which later on dried up. The hatching of the eggs, stored in the cool room (where the temperature varied from 30° to 60°F.), was more uniform than in the case of the eggs kept in the cooler room (where the temperature varied from 11° to 30° F.). Eggs properly kept in cold storage should hatch uniformly in a climate like that of Pusa on the 12th or 13th day after taking out of cold storage (*vide* Bulletin No. 48) ; but some of the eggs, sent to the cooler room, hatched irregularly two to three months after taking out of the cold storage and the rest dried up.

The eggs of Boropolu and Japanese races and their hybrids with multivoltine races hatch more uniformly than the eggs laid by other univoltine races under the same conditions. It has been seen further that the air of hibernating room should be pure and dry. Moist air prevents the exhalation of water vapour from the embryos and thus injures them ; very dry air also is injurious to the embryos.

The results also prove that Eri eggs (it should be noted that Eri silkworm is multivoltine) cannot stand a very low temperature and they fail to hatch if they are kept in cold.

Variations of temperature in hibernating rooms weaken the embryos and the worms which come out are feeble. In the worst cases they fail to hatch and die inside the eggs.

It should be noted that the eggs of multivoltine races are not sent for cold storage as they hatch naturally on the 10th to 15th day after oviposition. The hatching may be deferred by keeping them in a low temperature for a few weeks. (*Vide* First Report, page 19.)

Eggs of the above nine univoltine races (not Eri eggs) were also sent to Shillong and Muktesar where they were kept at a temperature varying from 50° to 30° F. These were sent in October and taken out in February for incubating ; almost all the eggs hatched uniformly and regularly in four days on the 12th or 13th day after taking out of the cold storage ; few embryos were injured and the hatching was quite satisfactory. It has been shown in the First Report that the eggs sent for cold storage to an ice factory, where the temperature varied from 35° to 45° F., hatched satisfactorily in three or four days.

In the silk-rearing districts of Japan, there are peculiar contrivances erected on the Hills known as Fu-Ketsu (wind-holes). A small cave is excavated on a hill on a side opposite to that from which wind blows ; the walls and the ceiling of the cave are filled up with saw dust or other non-conductors of heat. In these caves the temperature is always

about 35° to 45° F. when the outside temperature in summer and autumn varies from 45° to 95° F. Eggs are kept in such cold caves for hibernation and taken out in summer and autumn for incubating so that univoltine races can be reared any number of times in a year simply by deferring the hatching. The prosperity of the silk industry in Japan is primarily due to the use of such cold caves. Such caves may perhaps be constructed in the Hills of Upper Shillong and Naini Tal. Suitable cold rooms can also be made in those places where there are ice factories.

TABLE XII.

Maximum and minimum temperatures of the cool and cooler rooms.

Date	Cool room		Cooler room	
	Maximum	Minimum	Maximum	Minimum
	° F.	° F.	° F.	° F.
20th December 1915	59	48	30	19
21st " "	53	49	28	18
22nd " "	53	49	27	11
23rd " "	54	47	25	12
24th " "	54	49	28	12
25th " "	..	..	..	..
26th " "	58	47	31	14
27th " "	57	45	28	15
28th " "	..	..	..	..
29th " "	60	45	30	15
30th " "	..	..	..	..
31st " "	60	45	30	13
1st January 1916	..	..	..	..
2nd " "	60	54	30	13
3rd " "	56	50	28	12
4th " "	52	48	27	13
5th " "	52	48	28	12
6th " "	52	48	27	13
7th " "	55	52	26	12
8th " "	52	45	27	14
9th " "	..	..	..	..
10th " "	60	47	30	14
11th " "	52	45	27	15
12th " "	52	45	27	13
13th " "	52	45	25	14
14th " "	52	45	26	11
15th " "	52	45	24	13
16th " "	..	..	..	..
17th " "	56	45	30	15
18th " "	..	..	..	..
19th " "	56	45	25	13
20th " "	56	44	24	15
21st " "	54	42	25	12
22nd " "	52	45	25	11
23rd " "	..	..	..	..
24th " "	56	45	28	11
25th " "	52	47	27	13
26th " "	60	50	30	11
27th " "	54	45	30	13
28th " "	52	45	27	13

TABLE XII—*concld.*

Date	Cool room		Cooler room	
	Maximum	Minimum	Maximum	Minimum
	°F	°F.	°F.	°F
29th January 1916	52	45	26	13
30th „ „	..	..	..	..
31st „ „	50	46	30	15
1st February 1916	52	45	27	14
2nd „ „	52	45	27	13
3rd „ „	52	45	25	11
4th „ „	52	45	27	13
5th „ „	52	42	26	12
6th „ „	56	54	26	24
7th „ „	56	45	28	15
8th „ „	52	45	27	17
9th „ „	52	45	27	13
10th „ „	52	45	27	14
11th „ „	52	45	25	14
12th „ „	50	45	27	13
13th „ „	54	52	28	24
14th „ „	58	45	30	15
15th „ „	52	45	28	16
16th „ „	52	45	27	13
17th „ „	52	45	27	13
18th „ „	52	45	27	14
19th „ „	52	45	27	13
20th „ „	55	49	26	24

Conclusions.

1. Success has been attained in establishing multivoltine hybrid races which will yield better cocoons than the pure multivoltine races generally reared in Bengal, Assam and Mysore. A few eggs from each laying turn univoltine but they should be destroyed and multivoltine eggs should be reared. The loss of these eggs can be ignored considering the advantages gained. About 700, 800, 900, 1,050, 1,100, 1,300, 1,350 and 1,900 raw cocoons of univoltine race, Pusa hybrid No. 1, Pusa hybrid No. 2, Mysore race, Boropolu, Nistari, Chotopolu and Assam race, respectively, weigh 2lb. We recommend to rear Pusa hybrid Nos. 1 and 2 (Multivoltine varieties) in preference to any other varieties from October to April and from May to September respectively. Small quantities of these eggs will be available for distribution from the Imperial Entomologist, Pusa, Bihar if they can be spared when requisition is made for them.

2. All races yield more silk if fed with suitable tree mulberry leaves than when fed with bush leaves. Tree mulberry should be introduced in all localities in addition to bush.

3. Of all the indigenous races, the Mysore race is the best as far as the yield of silk is concerned. The Nistari race should be reared in

April or May, the Mysore race and hybrid races from July to October and univoltine races from October to March.

4. Of all the univoltine races, Chinese and Japanese races thrive best in a climate like that of Pusa but their yield of silk is inferior to those of France and Italy. The cross-breds between Boropolu and foreign univoltine races should be reared in those places where imported foreign races do not thrive well.

5. Univoltine eggs should be hibernated for about 4 or 5 months at about 35° to 45° F. The duration of cold storage can be shortened by the action of intense cold but the hatching of the eggs is quite unsatisfactory.

6. Eggs laid by moths which are attacked with flacherie can be used for industrial purposes.

7. Univoltine races are more susceptible to pebrine than multivoltine ones in a climate like that of Pusa. Pebrine appears more in May to October than in September to April. The more pebrinized layings are reared with healthy layings the less the number of cocoons are obtained from a rearing. The percentage of diseased moths is more or less in proportion to the pebrinized layings reared with healthy layings. Good crops and healthy layings can be obtained from a pebrinized laying if the worms are carefully attended to and if the temperature and moisture-content in the air are suitable for the healthy growth of the worms. Bad crops and pebrinized layings are obtained from a healthy laying if the temperature and moisture-content are high and if the worms are not properly looked after.

8. Multivoltine races cannot be improved by dipping the eggs in dilute hydrochloric acid.

9. *Morus alba* var. *japanica* and *Morus alba* var. *philippinensis* are the best foodstuffs for both univoltine and multivoltine races. There is practically no difference between the male and female varieties of mulberry which have been cultivated at Pusa.

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